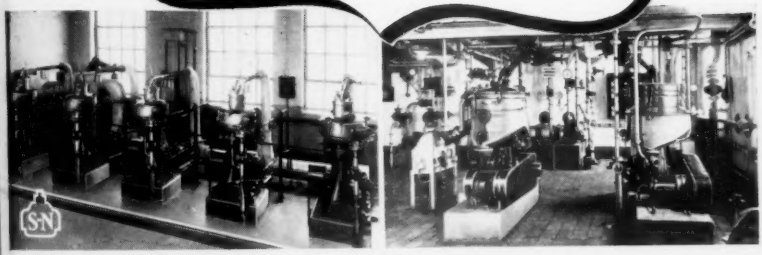
INSTITUTE OF PETROLEUM REVIEW

Published by The Institute of Petroleum
26 Portland Place, London, W.1

Volume 2. No. 21. September 1948. Price 2/-. Annual Subscription: One Guinea

PUBLIC LIBRARY
OCT 26 1948
DETROIT

145 REFINERIES
all over the world
use . . .



DE LAVAL S-N
CENTRIFUGES AND PROCESSES
for

SOLVENT DEWAXING
CONTINUOUS REFINING OF LUBE OIL, P.D., ETC.
PRODUCTION OF WHITE OILS

SOLVENT EXTRACTION
CONTINUOUS REMOVAL OF FULLER'S EARTH
CRUDE OIL DESALTING

Write for particulars

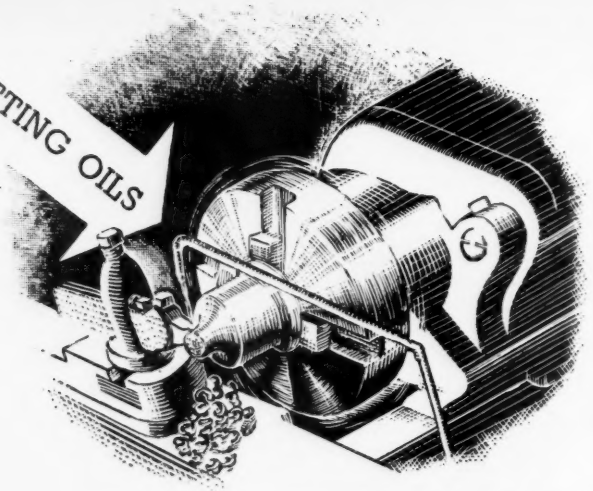
ALFA-LAVAL CO. LTD.
GREAT WEST ROAD
BRENTFORD, MIDDX.

SEPARATOR NOBEL CO.
STOCKHOLM 1
SWEDEN

DE LAVAL SEPARATOR CO.
165, BROADWAY
NEW YORK, U.S.A.

Smee's DL113

FOR CUTTING OILS



& CUTTING COSTS

SULPHURISED OILS

ARE INVALUABLE E.P. COMPONENTS

★HIGH TOTAL SULPHUR WITH
LOW FREE-SULPHUR CONTENT

★NON-CORROSIVE, NON-STAINING
WITH YELLOW METALS

More than an Additive
More than a Base . . .

ANCHOR CHEMICAL COMPANY LTD.
MANCHESTER 11

London Office: Grand Buildings, Trafalgar Square, W.C.2

Scottish Agents: J. & G. Hardie & Co. Ltd., 178 Fulton St., Glasgow, W.3

INSTITUTE OF PETROLEUM REVIEW

Hon. Editor: F. H. Garner, O.B.E., Ph.D., F.R.I.C.
Hon. Associate Editor: E. B. Evans, Ph.D., M.Sc., F.R.I.C.
Editor: George Sell

No. 21 SEPTEMBER, 1948 Vol. 2

CONTENTS

NOMOGRAMS AS A TOOL FOR THE TECHNOLOGIST, BY T. H. BLAKELEY 257
. . . TO CREATE CERTAIN OFFENCES, BY V. BISKE 263
NEW BRITISH PETROLEUM ORDERS 267
COURSES IN PETROLEUM TECHNOLOGY 268
RANDOM RECOLLECTIONS, BY JAS. S. PARKER 269
THE GENERAL SECRETARY AND THE EDITOR 273
COUNCIL COMMENTARY 274
U.K. PETROLEUM TRADE IN FIRST HALF OF 1948, BY GEORGE SELL 275
HYDROFORMING, BY C. M. CAWLEY 278
SBERNADORI'S PETROLEUM COMMERCIAL RULER, BY H. HYAMS AND B. C. FERGUSON 281
BITUMINOUS SAND SEPARATION 283

NOMOGRAMS AS A TOOL FOR THE TECHNOLOGIST

By T. H. Blakeley* (Member)

NOMOGRAMS, alignment charts, or line charts are now seen more frequently in our technical literature than they were twenty, or even ten, years ago, although for some unexplained reason they have never attained the same popularity in Britain as they have in the United States. This is undoubtedly a loss, for nomograms can be decidedly useful where it is necessary to repeat calculations of the same or similar type, and they are great time-savers. There seems to be a common feeling that an unusual depth of mathematical knowledge is required to construct nomograms. This feeling is almost completely unfounded, and the merest smattering of mathematics will suffice for anyone to construct the majority of nomograms seen in technical literature.

BASIC NOMOGRAMS

The simplest type of nomogram, yet one which is in its essentials basically the same as most published nomograms, is shown in Fig. 1. This nomogram solves the equation $a+b=c$. Thus, a straight line drawn from $a=3$ to $b=2$ cuts the c line at 5. The relation between the scales used for a, b, and c, and their relative distance from each other, is of course not haphazard. Thus, if the nomogram as drawn has 1 unit per inch on the a scale, and 2 units per inch on the b scale on parallel

* Esso Development Co. Ltd.

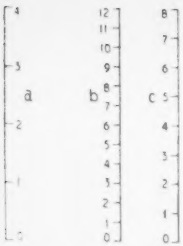


Fig. 1

lines, the c scale is automatically fixed — in this case at 3 units (i.e., 1+2) per inch—and its position is parallel to the a and b scales such that in this example the distance from the a scale is twice that from the b scale, that is, in inverse ratio to the number of units per inch on the respective scales.

The nomogram shown is readily altered to cope with expressions of similar type. Thus, for the equation $a+2b=c$, the b scale is halved so that 2 becomes 1, 6 becomes 3, and so on. For the equation $a+b=c+1$, the c scale is displaced one unit so that 1 becomes 0, 3 becomes 2, and so on. It is obvious that the basic nomogram also solves the equation $c-a=b$.

We can now generalize about the construction of nomograms of this type, for dealing with the equation

$$xa+yb=c-z, \qquad \ldots(1)$$

where x, y, and z are constants.

Referring to Fig. 2, the relation between the scales used (units per inch) is

$$S_c=xS_a+yS_b. \qquad \ldots(2)$$

The separation of the scales is given by

$$l_a \times xS_a=l_b \times zS_b. \qquad \ldots(3)$$

The mathematics required for this type of nomogram are therefore quite simple, but we shall show later that even this degree of acquaintance with the mathematical arts may be dispensed with in many cases.

It will not usually be necessary to construct nomograms for solving such simple problems in addition and subtraction. It is, however, frequently an advantage to construct a nomogram for multiplication and division, which after all is simply addition and subtraction of logarithms. To take a specific example, the capacity of a cylindrical tank is given by

$$V=4{\cdot}9\ d^2l,$$

where V is capacity in Imperial gallons, and d and l are respectively the diameter and length of the tank in feet. Taking logarithms, we have

$$\log V=2\log d+\log l+\log 4{\cdot}9,$$

which is of the same form as our general equation (1), replacing a by $\log d$, b by $\log l$, and c by $\log V$. It follows that if we make the length of scale occupied by one log unit (e.g. 1 to 10 or 10 to 100 or 100 to 1000), the same for tank diameter and tank length, then according to equation (2) the same length of scale will cover 3 log units of capacity (e.g. 1 to 1000 cu. ft.).

Application of equation (3) shows that the c scale, or tank capacity scale, will be located between the a and b scales so that its distance from the "length" scale is twice that from the "diameter" scale. Allowance for the constant (log 4·9) is made by fixing the capacity scale so that a line joining $d=1$ and $l=1$ cuts the scale at $V=4{\cdot}9$. In this way Fig. 3 has been constructed. Capacity in barrels has been added as an additional calibration of the volume scale; double calibration such as this is often useful where two systems of unit are in common use, and other applications will readily come to mind, such as doubling up the length and diameter scales with metric units.

Automatic Construction of Nomograms

We have already hinted that even simpler methods of nomogram construction are available. The most generally useful is the method of automatic construction. If the relation between three variables

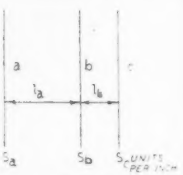


Fig. 2

a, b, and c can be expressed by

$$a \,.\, f(c) + b \,.\, f'(c) + 1 = 0,$$

where $f(c)$ and $f'(c)$ represent functions of c, then a nomogram may be constructed with a and b on parallel scales, and c on some other scale, not necessarily parallel to a and b.

The position of the c scale, and its calibration may then be fixed automatically. As it is now known that a calibrated "c" scale exists, it follows that there is only one point for a given value of c, although this will be given by different pairs of values of a and b. Hence, on choosing two or more such pairs of values, we can note the intersection of the corresponding lines on the nomogram and thus fix both a point on the c scale, and its calibration.

As a simple example of an equation conforming with the criterion given, the equation for the simple nomogram on Fig. 1

$$a + b = c,$$

may be rewritten

$$a \times \left(\frac{-1}{c}\right) - b \times \left(\frac{-1}{c}\right) - 1 = 0,$$

which is of the same form as the criterion, $f(c)$ and $f'(c)$ in this case being identical.

In using this criterion of nomogram constructibility, it must be noted that a and b may themselves be functions of some primary variable, in terms of which the scales are calibrated. Thus, if a is actually log (τ_i+const) the scale of τ_i will be constructed originally in terms of a, but will actually be marked with values of τ_i corresponding with various values of a. It must also be noted that one of the functions of c may be a constant, without affecting the validity of the criterion.

Let us consider the automatic construction of the tank capacity nomogram

$$V = 4{\cdot}9\, d^2 l$$

or $$\log V = 2 \log d + \log l + \log 4{\cdot}9.$$

Dividing by log V, and transposing all terms to the left side of the equation, we have

$$\log d \times \left(\frac{-2}{\log V}\right) + \log (4{\cdot}9l) \times \left(\frac{-1}{\log V}\right) + 1 = 0.$$

Comparing this with

$$a \,.\, f(c) + b \,.\, f'(c) + 1 = 0,$$

we see that it meets the requirements for the construction of a nomogram. Log d takes the place of a, so that the a scale is calibrated as a logarithmic scale of d—and the same applies to the b scale and log l, the multiplier (4·9) involving a relative shift in the l scale which is looked after automatically in the construction of the V scale. It may be noted that the form taken by the functions of V in the equation does not matter, provided that V is the only variable included in them. As we have already pointed out, the fact that the criterion of constructibility has been satisfied means that there must be only one point on the figure which corresponds with any given capacity. By choosing two sets of figures for diameter and length which give the same capacity, we can therefore locate the point corresponding with this capacity. Thus, 100 gal capacity is given by 2 ft diam and 5·1 ft length, or by 4 ft diam and 1·28 ft length. The intersection of these two lines on Fig. 3 gives the point corresponding with 100 gal. In a similar way, the location of 10,000 gal has been fixed by intersection. It may be noted that it is often desirable to use a third set of figures in locating each of the first two or three sets of points, as a check on the point of intersection. Needless to say, the accuracy of point location is greater if the locating lines meet at a good angle. When sufficient points have been fixed to establish the locus of the points—which in this case is the calibrated scale of tank capacity—then intermediate calibration may be rapidly filled in by marking the intersection of the locus with one set of

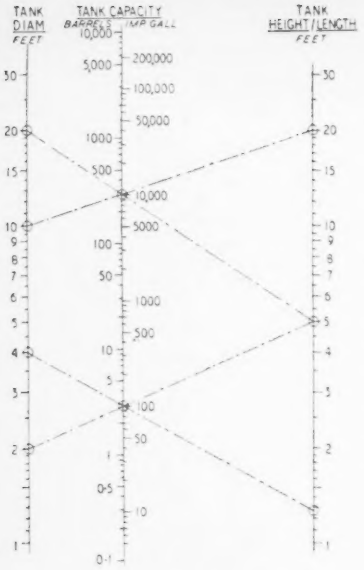


Fig. 3

figures only, as in the case of the 1000-gal calibration. When sufficient points have been located, the remainder can be filled in by interpolation.

As a further example of automatic construction, we will consider a nomogram for the following rather alarming expression:

$$C=\frac{10G-1{\cdot}0752\log(V-38)}{10-\log(V-38)}.$$

This is the expression for deriving the viscosity-gravity constant (C) of an oil, where V is the Saybolt viscosity of an oil at 100° F, and G is its specific gravity (60°/60°). This expression may be rearranged as

$$-G\left[\frac{10}{1{\cdot}0752\log(V-38)}\right]+C\left[\frac{10-\log(V-38)}{1{\cdot}07125\log(V-38)}\right]+1=0.$$

Compare this with the general equation

$$a.f(c)+b.f'(c)+1=0.$$

The viscosity-gravity equation is similar in form, which indicates that a nomogram may be constructed with parallel, uniformly, (or linearly) calibrated scales of G and C. The somewhat unwieldy appearance of the functions of V need not worry us at all—provided that they are functions of V, and V alone, we need trouble about them no more, but proceed to construct the nomogram. The difference in sign of G and C means that the scales must run in different directions, as in Fig. 4. Calculations shows that oils of 100 sec viscosity would have viscosity-gravity constants of 0·800, if the specific gravity were 0·850, and 0·861 if the specific gravity were 0·900. This fixes the position of the 100 sec viscosity point, as shown in Fig. 4, where the construction for locating the 10,000 sec point is also shown.

Comparison with Rectangular Coordinate Graphs; Empirical Nomograms

Having described methods of constructing nomograms, we may turn to some of their characteristics as compared with more customary graphical methods. In Fig. 5, graphs with

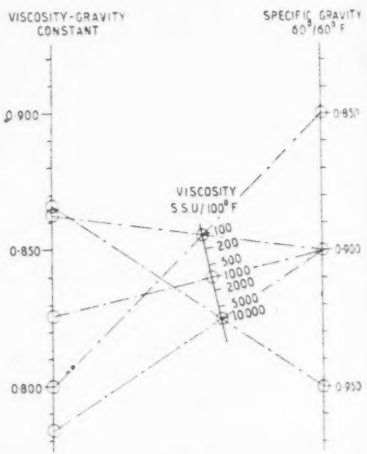


Fig. 4.

rectangular co-ordinates are compared with the corresponding nomograms. It is seen that if there is only one independent variable—i.e. for any value of a, there is only one value of b, and if this relation can be expressed as a straight line on rectangular co-ordinates, then a nomogram can be constructed, having two parallel scales for a and b, and a single point through which a line must be drawn to connect values of a and b. If a second independent variable c is introduced, and if the relation between a, b, and c can be represented by a series of straight lines, one for each value of c, then a nomogram can be made, with parallel scales for a and b, and another scale for c which is actually a locus of points derived by superimposing a number of one-independent-variable nomograms. Two points may be noted here. Provided that any collection of data can be expressed as a series of straight lines on rectangular co-ordinates, if necessary by adjustment of the scales of the co-ordinates, then a nomogram may be constructed empirically, by the same method as that used for automatic construction. Secondly, if all the lines

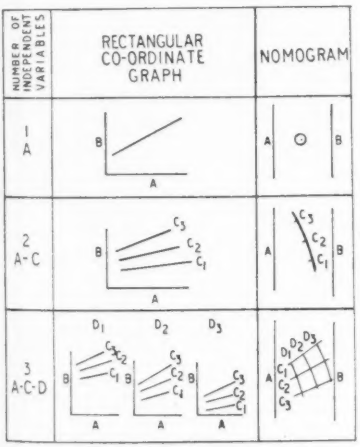


Fig. 5

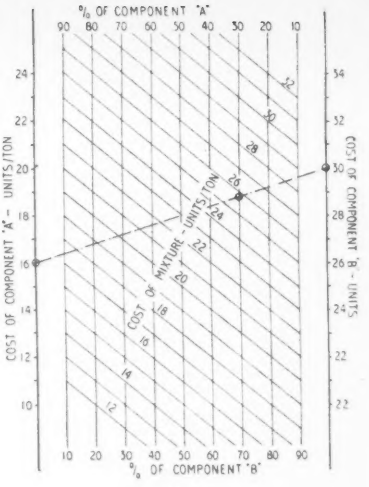


Fig. 6

on a graph are parallel, the c-scale of the nomogram is parallel with the a and b scales; if the lines intersect in one point, the c-scale is straight, but at an angle to the a and b scales; and if the lines do not all intersect in one point, the c-scale is curved.

When we pass to three independent variables, we run into difficulties with rectangular co-ordinates. Either we call in the help in the third dimension to cover the additional variable d, and use solid models or we have to employ a sheaf of graphs, one for each value of d, or we use some combination of graphs such as a "run-around" chart. With nomograms, however, we can still express our results in ordinary two-dimensioned paper, by having a network of scales for various values of c and d. Fig. 6 is a simple example of this type of nomogram, and deals with the calculation of the cost of a mixture of two compounds. This cost is determined by three independent variables—the unit cost of each component, and the composition of the mixture. Thus, a mixture of 70 per cent of a material

costing £30 per ton with 30 per cent of a material costing £16 per ton, would have a component cost of £25 8*s* per ton. Although this calculation is of quite a simple character, it was found decidedly time-saving, in dealing with a problem which demanded many calculations of this type, to spend the small amount of time needed for the construction of a nomogram covering the price range of the two components.

It is beyond the scope of this note to describe how expressions containing more than three or four variables can be treated nomographically. When more variables are involved, it is common practice to use rectangular co-ordinates, in the form of a "run-around" chart as already mentioned. Alternatively, a number of nomograms may be superimposed by means of reference axes, but in many cases, where the small amount of effort is justified by saving in time, it is worth while constructing a combination of slide rule and nomogram, on the lines described in *Engineering* (Aug 12, 1932). Another use for nomograms, which limitation of space prevents us from discussing, lies in the smoothing of experimental data, when this is expressible as a series of straight lines on a graph.

For those wishing to give further study to the construction and application of nomograms, there are numerous text-books available, such as Brodetsky's *Nomography*, and for those interested in the genesis of nomography there is the pioneer volume on the subject by d'Ocagne, who developed nomography in 1894 and coined its name. Many who read this will not have sufficient time available for this deeper study, and it is hoped that this brief discussion of simple methods of constructing nomograms will help in making this useful mathematical tool more generally accessible.

WILLIAM ROBERT GUY

MANY members of the Institute and particularly those associated with the Scottish Branch will have read with regret of the passing of William Robert Guy, the honorary secretary of that Branch. Tribute has been paid to him in an obituary notice in the *Journal* of the Institute and Dr A. E. Dunstan,

who had known him for over 30 years, sends the following tribute:

"Many of us who had occasion to visit Scottish Oils and the Scottish Branch of the Institute were well acquainted with Robert Guy. Not only was he an admirable secretary but always he conveyed a spirit of welcome and friendliness that was so characteristic of the man himself. One realized immediately that one was at home with him.

"His loss will be mourned by all his friends, not only in his home environment but wherever his kindly spirit made itself felt."

IRAN OIL PRODUCTION

Production of crude oil in Iran by the Anglo-Iranian Oil Co. Ltd., during the first six months of 1948 amounted to 11,476,000 tons.

". . . TO CREATE CERTAIN OFFENCES"

Some comments on the Motor Spirit (Regulation) Act, 1948.

By V. BISKE, (Fellow)

> Black spirits and white,
> Red spirits and grey,
> Mingle, mingle, mingle,
> You that mingle may.
>
> W. SHAKESPEARE, *Macbeth*, IV, i, 44.

DESPITE the exhortation of the witches, it has long been recognized that to mix one's drinks was an unwise procedure. Henceforth, as the price of regaining a somewhat limited freedom of the road, the private motorist must, at his peril, refrain from fuelling his engine with unauthorized blends, although the commercial vehicle may remain omnivorous and its operator can, in certain circumstances, use fuel of either hue.

The terms of the Motor Spirit (Regulation) Act, 1948, are somewhat less rigorous than those of the Bill as originally proposed. Many of the amendments were made in the House of Lords, being a good example of the value of the power of the Upper Chamber in enabling "second thoughts" to be incorporated in legislation. Nevertheless, the tendency of this Act is, unfortunately, to knock off a few more carats from the "golden thread",* now becoming more of a cupro-nickel, that innocence is presumed and that guilt must be strictly proven.

One of the principal improvements is the abandonment of the suggestion, made in the Vick report† (para. 64, (17)) that an analyst's certificate should be conclusive evidence of the facts therein stated. The procedure now laid down, enabling the defence to call for the attendance in court of the analyst, is similar to that which was in force during the war in connexion with the misuse of "government petroleum spirit" containing detector dye (S.R. & O. 961/42) and is on the same lines as that governing the calling of evidence in cases under the Food and Drugs Act, 1938.‡ Such a proviso is of especial importance in view of the fact that the Regulations (para. 4) specifically permit the addition of upper cylinder lubricant to petrol, the possibility of such a lubricant containing an inhibitor, perhaps even of an amine type, should be borne in mind. The nature of the analytical method applied and whether it was a general reaction for secondary amines, a colour test§ or a specific test for diphenylamine (such as the isolation and identification of a characteristic derivative) can, therefore, be elicited from the analyst in court by suitable questions put by or on behalf of a defendant. There is also the possible difficulty, previously discussed by the writer in another connexion,‖ that could be caused by oil/petrol mixtures used in two-stroke engines, particularly if the oil component were an additive-type oil.

Whilst elaborate requirements are laid down for the marking of petrol pumps supplying "commercial" and "private" grades, there does not appear to be, either in the Act, or in the only

* *Woolmington* v. *Director of Public Prosecutions* [1935] A.C. 482; but see Merchandise Marks Act, 1887 s. 2, for a presumption of guilt not unlike that in the Act under discussion.

† Cmd 7372.

‡ s. 81. It should be noted that, even if the analyst be not called, whilst his certificate is evidence of the facts therein stated (Motor Spirit (Regulations) Act, 1948, s. 11) it is not necessarily *conclusive* evidence and the court can take into account any other evidence it may have before it (*Hewitt* v. *Taylor*, [1896] 1 Q.B. 287).

The proviso that the analyst must be called at the request of the defence is included in many food regulations e.g. Food Standards (General Provisions) Order, 1944 (S.R. & O. 42/44 as amended by 654/44).

Sampling of Food Order, 1942, S.R.O. 531/42 as amended by 1199/42 and 2451/42.

Flour Confectionery (Control and Manufacture) Order, 1946, (S.R. & O. 418/46).

§ e.g. see *Chem. and Ind.*, 1948, 383.

‖ *I.P. Rev.*, 1948, **2**, 76.

statutory instrument (S.I. 1127/48, The Motor Spirit Regulations, 1948)* that has so far† appeared under it, any proviso requiring the labelling of cans. Undoubtedly the sale of motor spirit in cans is now the exception, but it still occurs in such places as some of the remoter Western Isles and can prices are still officially quoted.

Sampling

While sampling powers are given by the Act (s. 10) it is gratifying to see that samples taken from a motor vehicle, shall be taken in the presence of the owner, or person in charge thereof, "if practicable". (Presumably if the tank is locked it will not be "practicable" to take samples unless the owner or his representative is present.)

On this question of sampling, attention may be drawn to the fact that this may be carried out by police officers. Whilst we all admire the versatility of our police forces, it is, perhaps, permissible to raise a doubt as to their suitability and experience in the sampling of petroleum products, particularly if severe penal measures are liable to be taken as a result of the analysis of such samples.

The obtaining of a sample of motor spirit from the tank of a vehicle is, in many cases, a somewhat troublesome procedure, and will presumably call for special sampling devices such as a syringe with a flexible tube, or the like. Since one may assume that some, at least, of the tanks sampled may contain commercial petrol, it is obviously of the greatest importance, in order to prevent possible errors, that the sampling apparatus should be thoroughly washed out and the usual precautions against contamination taken before every sample is drawn. It is opportune to call attention to the provisions of I.P. Method 51/46 ("Standard Methods", 1948 edition, at p. 348) which states, "Official samples shall be taken by or under the immediate supervision of a person of a judgement, skill and experience *in sampling*" (italics added). Can we really rely on the average policeman who is put on petrol patrol duty, coming within this definition?

A further point which may be mentioned in connexion with sampling is, that whilst it is an offence to have commercial spirit in a *tank* of a private motor vehicle, the sampling clause provides that samples may be taken of any motor spirit which is *in* a motor vehicle. As will be mentioned again later, private motor boats are legitimately fuelled with commercial petrol. Since motor boats are normally kept at some distance from petrol pumps, it may well be expected that cans of spirit for fuelling such boats may be carried in private motor vehicles to and from harbours and other places. If such a can is sampled under s. 10 (2) of the Act, upon whom is the onus of proving that such spirit was not for use in the vehicle?

Whilst the Act does not specifically deal with this point some guidance may be obtained from the wording of S.R. & O. 952/29, which deals with the storage of petroleum and in which (para. 6 (1) (a)) a distinction appears to be made between petroleum spirit contained in the tank of a vehicle and that "otherwise carried on" a vehicle. It could, perhaps, be argued that motor spirit in a can carried on a vehicle was not "in" the vehicle but "on" it. Moreover, although by s. 2 (2) it is an offence to acquire commercial petrol for use in a private motor vehicle, this section does not appear to raise any presumption of guilt, and thus it would be necessary for the prosecution to prove that such spirit had been acquired for such an illegal use.

* The I.P. "Standard Methods" are referred to in these Regulations, but with a slight error, they are "Standard Methods *for* Testing, etc.", not "*of* Testing", as given in the Regulations.

† At the date of writing, June 8, 1948.

What Exactly is "Commercial Petrol"?

Para. 3 of S.I. 1127/48 states that "The prescribed ingredient (which, when added to any motor spirit shall for the purposes of the Act make that motor spirit commercial petrol) shall be diphenylamine." Neither this paragraph, nor any other portion of the Instrument or of the Act, however, states how much diphenylamine is to be added. Obviously the amount of this chemical contained in commercial petrol is of importance, particularly so in cases where tests show only a very small quantity to have been present. If the concentration used is high, a small amount found may well be due to accidental slight contamination at either the wholesale or retail stages of distribution; if, however, the concentration of the "prescribed ingredient" is low, then even a trace may indicate misuse. It is obviously desirable that there should be a statutory minimum amount of identifying ingredient in commercial petrol, but at the time of writing there does not appear to be any regulation covering this point.

A further aspect is that the Act and the Regulations do not appear to lay down any penalty on a distributor or producer who should put on the market an allegedly commercial petrol from which the "prescribed ingredient" is absent. Red dye alone is not enough to class a motor spirit as "commercial petrol". Therefore it would appear that the gratifying conclusion can be drawn (unless such omission is an oversight) that the reputation of the petroleum industry is such as to make a proviso of this nature unnecessary, it being considered sufficient to apply the safeguards at the retail distribution stage.

Some Apparent Exceptions

A remarkable loophole of the present legislation is the fact that although the pleasure motorist on land has had his access to illegal petrol effectively stopped, the pleasure motorist on water would appear still to have the "black market" readily available.

Pleasure motor-boats are issued with a ration of one-third that in force in 1947; however, the coupons by means of which this is rationed are the type which it is lawful to exchange for commercial petrol. Hence any motor-boat owner who can "fiddle"* some commercial gasoline is in the same position as the private motorist was in previous years under the "basic" régime—he need fear no examination of his tank contents, since whether the petrol be legitimate or illegitimate, the colour and tests will be the same.

This might raise an interesting problem—what would be the position of a person running a private amphibian vehicle? Whilst undoubtedly this, if run on land, would have to be registered as a motor vehicle, the moment it enters the water it will be a motor boat, legitimately running on red petrol and not white. Must the owner fit two tanks? Will some enterprising owner test the position, or will this remain an amusing conundrum?

The Act, and the regulations so far made under it, only deal with road vehicles. Presumably private aircraft are in the same position as motor boats, although in the case of aircraft the necessity, under the various enactments dealing with aerial navigation, of keeping log books recording all flights, would provide a check on the amount of fuel used.

Social and Moral Aspects

We have heard much about faults, moral and otherwise, of the "black market". Whilst this form of trading appears to have become widespread in many other European countries, it has always been a source of satisfaction that its extent in Great Britain has been relatively slight. One exception appears

* A term of respectable antiquity dating back to 1604.

to have been in the case of petrol and in the Vick report (para. 3) considerable stress is laid on this and it has also been stated that the lowering of the moral standards of the community has been responsible for illegal petrol transactions. This is surely "putting the cart before the horse" and it is much fairer to say that the continuation of rationing of motor fuel, the necessity for which was not sufficiently appreciated, had lowered the moral tone of the community!

It is significant that in the case of those articles where the rationing is fixed and inflexible, such as food and clothing, the "black market" is only very small and not brought to the awareness of the average law-abiding citizen.

Now, as regards food and clothing, the amount granted to every inhabitant is (with minor exceptions such as invalids and workers in certain occupations) rigidly fixed, and it is not possible, legally, to acquire additional supplies. In the case however of motor spirit, quite apart from supplementary rations granted for specified purposes, this commodity is the only one which, although rationed, can be legally acquired by an individual for his own unfettered use, in an amount restricted only by the length of his purse. However much money a man may have, he may not (for consumption at home and not in restaurants) buy more than the specified ration of, say, butter. If, however, he wants to motor for pleasure, by the simple expedient of buying a number of motor cars, licensing and insuring each one, and then obtaining the basic or standard ration in respect of each vehicle the total amount of petrol so consumable, in a perfectly legal manner is, in theory at least, unlimited.

Moreover, although private motoring in Britain is severely restricted, there is no restraint on indirectly utilizing gasoline by air travel for holiday purposes; the more people travel the more planes the air companies will lay on. A man owning one car may not legally do more than his meagre 90 miles, or thereabouts, per month, but if he wishes to fly to, say the West Indies, for purely pleasure purposes, he may do so and his share of the fuel consumption of the aircraft will be in the region of 100 or so gallons of high octane fuel.

It is considerations such as these that weaken the complaints regarding the regrettable fall of the moral attitude of the population. However, these are only thoughts by the way, and it seems reasonably certain that the present regulations, even if only by the extreme severity of the penalties that they impose, will effectively stop most, if not all, of the leakages complained of hitherto. The Vick report (at p. 22) states that "Honesty cannot be universally enforced by regulation". The present Act is, however, making every attempt to do this, and it will almost certainly succeed. Moreover, it should command public support and, if the occasional cases of genuine mistake that occur are treated with understanding, the public may well come to regard "commercial petrol" as a separate commodity quite distinct from fuel for private vehicles. After all, the use of kerosine has long been banned in cars, and although the penalties attending such use do not approach in severity those now introduced, there does not appear to have been any appreciable misuse of kerosine for cars despite its being unrationed. Whilst this may be largely due to the technical disadvantages, the fact that it is not "petrol" undoubtedly has much to do with this. The motoring public should regard commercial petrol in the same light, namely a liquid hydrocarbon fuel which will burn in car engines but which must not be so used.

There is moreover, in the Act itself, a gleam of hope. Most Acts of Parliament can only be repealed by Parliament itself, usually a somewhat slow procedure. In the Act under discussion

s. 16 (2) expressly provides that it may be repealed by an Order in Council.

With temptation placed beyond the reach of all except those who are either fools or criminals, the average motorist, if stopped by a police patrol should, even if the contents of his tank are legitimately jaundiced, have a conscience that is, like Kipling's Gunga Din, "white, clear white inside".

N.B.—It is interesting to note that the Petroleum Board, which it must be remembered was, strictly speaking, a company and not a Government department, is, by s.3 (1) specifically empowered to authorise acts which would otherwise constitute an offence under the Act. No amendment to this section appears yet to have been issued, consequent upon the dissolution of the Petroleum Board; presumably its successors are within the description of "a person authorised by the Minister of Fuel and Power" mentioned in that section.

NEW BRITISH PETROLEUM ORDERS

Orders recently made by the Minister of Fuel and Power or the Home Secretary, and which relate to the petroleum industry are:

The Control of Petroleum (Amendment) Order, 1948.

This Order (S.I. 1948, No. 1420) makes amendments to the Control of Petroleum Order, 1944, necessary on the dissolution of the Petroleum Board and certain amendments to clarify the provisions of the original Order.

The restrictions on disposal of petroleum (which includes aviation spirit, motor spirit, kerosine, gas, diesel and fuel oils, lubricating oils, white oils, and other petroleum products) remain unchanged for suppliers, but buyers will no longer be required to see that their supplier holds a licence.

The Benzole and Allied Products (Control) Order, 1948.

By this Order (S.I. 1948, No. 1419), the Control of Benzole and Allied Products Order, 1945 is revoked and its provisions re-enacted with amendments necessary because of the dissolution of the Board, and certain other amendments.

Prices for benzoles other than crude and motor benzoles are maximum instead of fixed prices. There are no price provisions for crude and motor benzoles.

Dealings in refined benzoles are controlled by licence to supply instead of licence to acquire (in the case of motor benzole, by supply licences to producers and refiners).

Provisions fixing the charges for the hire of drums and barrels are omitted. Where a price fixed under the Order is "ex-works" and a contract is made at a price including delivery, the latter may include only the expenses actually and necessarily incurred by the seller in making delivery.

The Petroleum-Spirit (Conveyance) Regulations, 1948.

This new regulation (S.I. 1948, No. 1758) amends Regulation 9 (i) of the Petroleum-Spirit (Conveyance) Regulations, 1939, for the purpose of facilitating the conveyance of certain loads of petroleum spirit, e.g. lighter fuels in glass bottles instead of only in strong metal vessels as hitherto required. Vessels may contain not more than one pint each and may be packed into an outer container holding not more than three gallons in the aggregate.

BRANCH MEETINGS

NORTHERN BRANCH

Additives in Perspective. E. A. Evans, at Engineers' Club, Manchester. 6 p.m., October 19.

SCOTTISH BRANCH

Development of Engineering Equipment for Distribution of Petroleum Products. R. E. Adlington, at Heriot-Watt College, Edinburgh, October 29.

SOUTH WALES BRANCH

Accuracy in Oil Measurement Operations. H. Hyams, at Britannia House, Llandarcy 5.30 p.m., October 22.

STANLOW BRANCH

Higher Hydrocarbons in Service. E. A. Evans, at Thornton Research Centre, 6 p.m., October 20.

COURSES IN PETROLEUM TECHNOLOGY

Details are available of courses in petroleum technology and allied subjects which are being held during the winter. These are summarized below:

SIR JOHN CASS TECHNICAL INSTITUTE

General Technology of Petroleum

Commencing on October 7, 1948, this course consists of nineteen afternoon lectures and two visits, one to the refinery at Fawley and the other to Shell Haven. The introductory lecture deals with the types of products obtained from petroleum, the origin of petroleum, and the hydrocarbon types present, and the second lecture is on the winning of petroleum and the principles of fractionation.

Combustion is covered broadly in two lectures, following which fuels, lubricants, bitumens, and special products are discussed from various aspects. The last three lectures cover respectively storage, transport and measurement, and research and development.

The fee for the course is 30*s*., and details and enrolment forms are available from the Institute, Jewry Street, Aldgate, E.C.3.

The Internal Combustion Turbine

This course of three lectures on the development, characteristics, and application of various gas turbine cycles starts on November 4, 1948, and continues on successive Thursdays at 6.30 p.m. Problems yet to be solved will be discussed. The lecturer is W. Tipler, and fee for the course is 5*s*. Application forms are available as above.

NORTHAMPTON POLYTECHNIC

Fuel-Fired Furnaces

A series of five lectures on the design and operation of fuel-fired furnaces, with special reference to recent developments, commencing on Tuesday, October 5, 1948, at 7 p.m. The first three lectures deal with the production and properties of (*a*) solid fuels, (*b*) liquid fuels, (*c*) gaseous fuels. The design and operation of gas and oil-fired is the subject of lecture (*d*) while the concluding lecture is on the firing of power station boilers.

Fee for the course is 21*s*., and enrolment is by personal attendance at the Polytechnic office (10 a.m.–7 p.m.), at St John Street, London, E.C.1.

Refractories

The technology of refractory materials is the subject of ten lectures at 7 p.m. on Wednesday evenings from October 6, 1948. Fee is 12*s*. 6*d*., and enrolment is as for the preceding course.

ACTON TECHNICAL COLLEGE

Chemistry of Oils and Fats

This course is in three parts, each of four lectures, at 7.30 p.m. on Fridays commencing on September 24, 1948. Part 1 is on analysis of oils and fats (*Sept.* 24 *to Oct.* 15), Part 2 on chemistry of deterioration in fats (*Oct.* 22 *to Nov.* 12), and Part 3 on drying and polymerization of oils (*Nov.* 19 *to Dec.* 10). Fees are 10*s*. for each part or 30*s*. for the complete course, and application should be made to the College at High Street, Acton, London, W.3.

Inorganic and Physical Chemistry

Commencing on January 7, 1949 at 7.30 p.m., this series of twelve lectures is in three parts of four lectures. Part 1 (*Jan.* 7 *to* 28) is on the subject of recent advances in analytical chemistry, Part 2 (*Feb.* 4 *to* 25) on valency, theory and complex formations, and Part 3 (*Mar.* 4 *to* 25) on recent advances in electrochemistry. Fees and application data are as mentioned above.

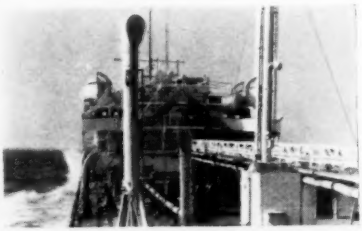
RANDOM RECOLLECTIONS

By JAS. S. PARKER (Fellow)

EVERYONE at home envied my recent trip to South America and said so. If anyone in South America envied my trip home they forgot to mention it.

A modern tanker, according to the ship's officers, is good for seven years on white oils and a further thirteen years on black oils. This twenty years' service pays for the tanker. Thereafter it is all profit. Anyone got a twenty-year-old tanker?

These modern tankers have first-class accommodation for a limited number of passengers. Deck space is, however, comparatively sparse; one is thrown



back on one's own resources for entertainment and tankers keep to the open sea from port to port. The interest curve tends to sag badly on the last stretch.

A ship! A ship! Everyone scurries on to the deck to gaze at another tanker wandering across the skyline. A school of porpoises, a whale, some flying fish. The engineer stops the engines to clean the fuel sprayers and the passengers fish off the tail end. They catch nothing. What would you expect them to catch in sea a mile or two deep?

The first officer prefers long voyages of six months' duration. The chief engineer prefers sitting in front of a coal fire at home. There is no argument about it. The first officer inhabits the middle of the ship and the chief engineer the tail end.

According to the engineers these super speedy tanker turn-rounds are not all they are cracked up to be. There is no time for minor repairs. These trend to build up either into a major breakdown or considerably increased docking time when the tanker is in for overhaul.

Caps on! Caps off! All helmsmen wear caps even though the bridge is totally enclosed and has windscreen wipers, de-icers and all the gadgets. One wears an American cotton cap with peak turned up American fashion. Another wears a beachcomber's two-foot straw hat. Then the Iron Man takes over. He is down below in a special room remote-controlling the helm which in turn remote-controls a massive set of hydraulic rams in the tail end directly connected to the rudder.

The Iron Man, or the Sperry gyro compass, is based on the gyroscope with numerous auxiliaries correcting for roll and pitch, position with regard to the equator, and what have you. The Iron Man knows more about it than I do, even after the second officer's explanation.

One's first impression of Trinidad when approaching by night is that the island is on fire. Two brilliant adjacent field flares blast the blackness—six million cubic feet of gas from the new Penal field. The quantity has got ahead of piping facilities. Consideration is being given to operating gas on a

co-operative basis between the local oil companies.

Trinidad appears to be living up to its reputation of not abiding by the rules of the game. A geologist once explained that it was not his job to state where the oil was. His job was to state where the oil wasn't. As Trinidad does not abide by the rules there have been numerous wasn'ts where the oil was. With few exceptions every producing field has been turned down flat by some geologist at one time or another.

In the twenties there were four known oilsands in a zone termed the Cruse Zone. These sands were lettered from A to D in that order of depth. As the formations were lenticular all these sands were not encountered on every location. Some might have petered out. One certain thing these days, however, was that anyone drilling below D was nuts. D was of the order of 3000 feet. On this reckoning Trinidad is nuts today. Deep drilling is on all schedules. Penal, where the two flares are situated, is producing from 8000-feet, 1800-barrel wells beaned down to 800/900 barrels. A new series of sands has been located at this depth.

Formerly an oil executive's job abroad was reasonably quiet. Contact with H.Q. was long range, mail boats took a reasonably long time to bring back the answer and visitors were few and far between. Nowadays air mail brings back the answer before breakfast and if a director has a liver on a Monday morning he hops on a plane and is on the field in two days. A head executive's job abroad these days is largely concerned with entertaining visitors and attending conferences. Winter at home is the peak season for urgent business abroad.

In the twenties the oil fraternity in Trinidad were one family socially. Everyone knew everyone else, no matter on what field he was located. Nowadays the camps have grown to such an extent that some do not know others in their own camp.

In general, Trinidad scenery has altered little since the twenties—the same sugar-cane plantations, the same bamboo, the same bush. The oil refineries have grown to unrecognizable dimensions and there has been some cleaning up here and there. The main Port of Spain hotel has a concrete façade and a chromium-plated bar. Complaints remain as numerous. The fields have built an inter-connecting road between Palo Seco and Point Fortin controlled by their own police force. Macqueripe, the prize bathing spot of the island, is off the map. It is in the U.S. zone together with the island of Gasparee. As recompense the U.S. Services built during the war, reputedly with around 10,000 G.I.'s, a road to Maracas Bay on the north coast. Another road was engineered by them during the war from Port of Spain to their airfield near Arima. These roads are wide and metalled. There are similar road improvements round San Fernando but the Southern Main Road is worse than ever. Housing schemes proceed as at home and Coca Cola has invaded the Island as it has done most South American countries where U.S. Services have been in residence.

The West Indies cricket Test Match hit the headlines. There was an almighty row because some fishermen had been shot up whilst trespassing in the U.S. zone. If there was any reference to the European question it was barely noticeable. Trinidad lives in a backwater all on its own.

Dollar shortage was catching up on Trinidad. U.S. and Canadian goods were diminishing in supply. The shopkeeper's pre-war interest in the buyer was still very much in evidence. Coupled with no requirement for coupons this proved initially expensive for the U.K. visitor.

No individual rationing of imported foodstuffs was in evidence though the supply was not full. Rice, the staple diet of the Indian coolie, was a short crop last year. A system of rice rationing was introduced to safeguard him. Households previously not interested in rice took up their ration and the coolie got less than ever.

The waters around Trinidad abound with fish yet fish is almost unobtainable. Fishermen can make more money in industry with less effort.

In the U.K. an American car is conspicuous and the subject of some sarcastic comments. In Trinidad, where the American car predominates, it fits into the landscape. The small British car, not markedly in evidence, is conspicuous by its oddness. In the U.K. the American car looks futuristic. In Trinidad the British car looks out of date.

The Island is saturated with taxis, ninety-nine point nine per cent of which are big American cars. Taxi drivers retain a speed complex. Oilfield drivers have vastly improved in technique.

Uriah Butler was under a form of preventive detention in Port of Spain but remained a pain in the neck to industry. Having failed in his attempt to gate-crash the official oilfields union with his breakaway union he had transferred his attention to sugar-cane. Here he had gained a certain number of adherents, mainly on one plantation. These coolies were on strike during the crop season and filling in their spare time by setting fire to odd fields of sugar-cane.

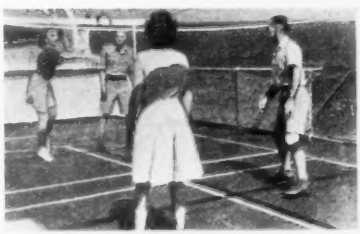
Trinidad is mainly sugar and oil, the latter being a comparative newcomer. Niggers, originally from West Africa, and coolies from India were brought to Trinidad years ago for the sugar-cane industry. The nigger gravitated to the oil industry. The coolie remained on the cane fields.

Butler's influence on the nigger, especially his Grenadian countrymen, is easy to understand. The nigger still retains his mystic religious complex. Butler's influence over the coolie is not evident on the surface. One has to look behind to the reputed source of a large part of his financial backing. This is local and for other reasons than that of the Communist creed.

Butler's reputed technique when at large was unusual. He would breeze on to a location crowned with roses. The following disciples carried a chair. When Butler was seated the disciples were blessed. Prayers and hymn singing alternated until the "congregation" had gathered when Butler let fly at whatever he had on his mind. Now that his movements are restricted he issues at intervals the crudest form of broadsheet and organizes free meals for his striking adherents.

The labour trouble black spot in the Trinidad oil industry is not so much Butler as the thousand or so squatters at Point Fortin. These men were laid off with official union approval some years ago. They squatted in the bush. Coconut leaves and bits and pieces of local wood provide shelter. Food grows. They still squat.

So they said! The crews of German submarines visited the picture houses in



Barbados. To prove this they handed the ticket stubs to local fishermen from whom they obtained fish at sea.

In the old days if you did not actually have one foot in the grave it was highly probable that you would receive somebody else's medicine. And it probably did you as much good. Nowadays the hospitals provided in all oil camps are more pleasing and better equipped than the majority at home.

In the old days the water supply originated from the bungalow roof. Nowadays it is laid on, controlled, and purified from special water wells. The nigger sticks to rain-water. The purified water, in his estimation, makes him impotent.

So they said! During the submarine period in the Caribbean, tin fish were prevalent immediately a ship got outside the Trinidad Bocas. A ship would scream an S.O.S. The U.S. Air Force would report no submarines in sight anywhere. An R.A.F. Coastal Command squadron was loaned to instruct. Stooging round to find the lay of the land after arrival the squadron leader bagged one submarine. During the instruction period the squadron raised the score to double figures. Competition does not breed popularity.

A major percentage of Caribbean air passengers were coloured. A nigger, his wife and four children, the eldest aged four. They were travelling from Paramaribo to Curacao mainly over open sea with the last two hours in darkness. A coloured woman turned up with an outsize in wardrobe trunks as luggage. To a large extent they have jumped from donkey transport to air transport missing out the intermediate train and motor-car stages.

(To be continued)

TRINIDAD BRANCH

A number of members of the Trinidad Branch accepted the invitation of His Excellency the Governor to be present on July 5, 1948, at the opening of the Colonial Microbiological Research Institute at Port of Spain, Trinidad.

Lord Hankey, chairman of the Colonial Products Research Committee, performed the ceremony. In his opening address he outlined the steps which had led to the foundation of the Institute and referred to the work it proposed to undertake "for the benefit of all mankind". It was not a "Trinidad" project only, he said, but would extend to all comparable regions. Among the reasons which led to Trinidad being selected as the site for the Institute was "the prospect of invaluable contacts with the scientists of the Trinidad Government and of the refineries, oil companies, and other industrial concerns in the Island".

FLEXIBLE TUBING

FLEXIBLE metallic tubing for use in the petroleum industry for the conveyance of steam, liquid fuels, lubricating oils and liquid asphalt is specified in B.S. 1465: 1948, just issued by the British Standards Institution. Details of construction and dimensions are given according to temperature of use. Copies of the specifications, price 2*s*. post free are obtainable from the Institution at 24–28 Victoria Street, London, S.W.1.

THE GENERAL SECRETARY AND THE EDITOR

As announced in our last issue, F. H. Coe, general secretary of the Institute since 1942, resigned from that position on July 31.

Derek Allan Hough, who has been appointed as the new general secretary with effect from September 1, was educated at Wrekin College, and before the war was a member of the Liverpool Stock Exchange. Throughout the war he served with the Royal Corps of Signals and held the rank of captain. During his time with the army he was one of those who saw active service first in North Africa, then on the Anzio beachhead, and through to the Gothic Line. Since leaving the army Mr Hough has been acting as secretary to a private company and has enhanced the secretarial and accountancy experience which he will now bring to the benefit of the Institute.

Mr Hough, who is married and has two children, is a keen golfer and is proud of his scratch handicap. He is equally proud of having won the Public Schools Hurdles Championship in 1928.

Members of the Institute will find the new secretary very genial and on their behalf we welcome him to his new sphere of activity.

THE EDITOR

It is with pleasure that we announce also the appointment of George Sell as editor of the Institute's publications, a post which has been created to bring that sphere of the Institute's activities into its proper perspective.

George Sell needs no introduction to most of our readers. While he has since 1946 been publications secretary, it must not be overlooked that he gave considerable service to the Institute in a previous period. In fact he has been associated with the Institute since its foundation in 1913, when he was employed by the Founders —the late Sir Boverton Redwood and Arthur W. Eastlake. Later he acted as assistant editor, librarian, and secretary to the Standardization Committee for a number of years until he resigned in 1936 to join the staff of *Petroleum Times*. The war saw him as an Assistant Regional Petroleum Officer with the Ministry of Fuel and Power, after which he returned to *Petroleum Times* for a short period before rejoining the Institute's staff in 1946.

OIL SEARCH IN MOZAMBIQUE

Mozambique-Gulf Oil Co., a wholly-owned subsidiary of the Gulf Oil Corporation, has been granted a concession for oil exploration and development over an area of 45,000 sq. miles in Mozambique.

As no adequate maps of the area are available the first step in the search for oil is the preparation of aerial maps. For this purpose the Aero Service Corporation of Philadelphia commenced to photograph the area at the end of July. The maps thus obtained will be used first as a guide for an airborne magnetometer survey and later for the oil company's development planning.

COUNCIL COMMENTARY

COUNCIL members, when they met on July 14, heard first the sad news of the deaths of William Robert Guy and Mrs H. C. Tett, and accorded tribute of respect by standing in the usual way.

After the minutes had been approved, matters arising were dealt with, the chief item being concerned with Council committees. Various alterations were proposed and accepted.

It was decided that on Awards, Benevolent Fund, By-laws, Election, Finance, and House committees, only Council members should be appointed. Reports were discussed dealing with Branches, Education, and Election.

Mr Thornley presented the report of the Branches Committee, which dealt with the activities in the direction of forming branches in Abadan and Australia, with the question of a capitation grant to branches, and also with reports from the branches. These latter showed a gratifying increase in branch membership paralleling the increase in parent body membership.

Mr Pracy was appointed by Council on the recommendation of the Branches Committee as a liaison member for overseas branches and to encourage the formation of new branches. The question of capitation fees is also to be reconsidered.

The draft rules for the South Wales Branch were approved by Council, as was also the recommendation that the capitation grant for student members of the Institute should be paid to Birmingham Students' Section as soon as officers and committee had been appointed.

A brief report from the Education Committee again drew attention to the lack of facilities for further education catering for members abroad and the need for advice on text-books, courses of reading, or even approved correspondence courses being available.

The Election Committee submitted a report and some discussion took place on the recommended placing of certain candidates.

The alteration made under the revised by-laws whereby Member and Fellow are senior grades of equal standing is not, as yet, widely appreciated. Differentiation between grades is now solely on the grounds of occupation in the industry, i.e. whether technological and scientific, which is the basis of Associate Fellowship and Fellowship grades, or administrative or other eminence, which distinguishes the Associate Membership and Membership grades.

Correspondence and discussion ranged over subjects like the World Petroleum Congress, the desirability of a social function during this session, the representation in the Institute of Fuel (the Honorary Secretary being asked to represent us in this Institute) and the Empire Council of Miningand Metallurgical Institutions, to which four papers were to be contributed on the petroleum side.

Dr A. E. Dunstan had asked to be relieved of his duties as representative of the Institute on the Empire Council in view of his being no longer resident in the London area, and this decision was received with regret. Mr T. Dewhurst was appointed to represent the Institute with Mr C. A. P. Southwell.

Appointments to B.S.I. committees were confirmed and an appreciative letter from Mr Burroughs following his recent visit with Mr Detwiler was mentioned by the President.

KUWAIT OIL PRODUCTION

The production of crude oil in Kuwait by the Kuwait Oil Co. Ltd., during the first six months of 1948 was 2,031,134 tons.

U.K. PETROLEUM TRADE IN FIRST HALF OF 1948

By GEORGE SELL (Fellow)

TOTAL imports of crude petroleum and refined products into the United Kingdom during the first six months of 1948 amounted to 2,226,379,000 gallons, valued at £76,312,863. Details from the official return* are given in Table I.

Compared with the corresponding period of 1947 the increase in total quantity is 50 per cent and the total value is nearly doubled with an increase of 92·1 per cent. This increase in quantity was shared by crude and all products except spirit and lubricating oil. The largest percentage increase in quantity was for fuel and diesel oils (189 per cent), with gas oil at +69·6 per cent, crude petroleum at 62·6 per cent, and kerosine up by 17·8 per cent.

In the case of solid products all showed considerable quantitative increases over the first half of 1947. The highlights are natural asphalt and bitumen, which increased by 63·9 per cent in the comparable periods, and carbon black from natural gas with an increase of 63·1 per cent.

AVERAGE VALUES

As noted above the total value of petroleum imports in the first half of 1948 was nearly double the value for the same period of 1947. This increase was shared by crude petroleum and all liquid products. In Table II the c.i.f. values have been calculated on the basis of the units employed in the official return.

The largest increase in average value was that of 52·4 per cent for gas oil,

TABLE I

QUANTITY AND VALUE OF U.K. PETROLEUM IMPORTS

	January to June, 1948		January to June, 1947		Half of Year, 1938	
	Quantity 1000 *gal*	*Value* £	*Quantity* 1000 *gal*	*Value* £	*Quantity* 1000 *gal*	*Value* £
Crude petroleum ..	483,999	12,854,317	297,667	6,266,571	283,978	2,588,768
Motor spirit	541,659	21,522,261	569,820	16,464,881	728,334	12,382,462
Other spirit	12,654	598,792	11,519	392,984	9,048	155,292
Kerosine	200,446	7,425,694	170,163	4,518,884	103,182	1,502,240
Lubricating oil ..	46,448	4,268,387	49,751	3,790,060	54,100	1,976,908
Gas oil	245,573	8,864,165	144,782	3,429,464	78,964	1,062,808
Fuel and diesel oils ..	695,559	20,762,077	240,648	4,857,655	343,670	3,285,230
Other sorts	41	17,170	—	24	478	36,392
Total refined products	1,742,380	63,458,546	1,186,683	33,453,952	1,317,776	20,401,332
	Cwt		*Cwt*		*Cwt*	
Paraffin wax.. ..	488,857	1,569,432	349,203	1,026,367	404,876	317,520
Mineral jelly ..	123,172	217,741	113,792	198,184	68,190	77,866
Carbon black from natural gas ..	456,300	1,391,171	279,800	783,062	193,106	256,376
	Tons		*Tons*		*Tons*	
Natural asphalt and bitumen	23,594	240,429	14,398	171,730	39,582	145,472

* "Accounts Relating to Trade and Navigation of the United Kingdom, June 1948." H.M.S.O., London.

TABLE II

AVERAGE VALUES OF U.K. PETROLEUM IMPORTS

	1948	1947	1938
	£ *per* 1000 *gal*		
Crude petroleum ..	26·54	21·05	9·01
Motor spirit ..	39·73	28·89	17·00
Other spirit ..	47·32	34·12	17·16
Kerosine	36·55	26·55	14·56
Lubricating oil ..	91·96	76·18	35·54
Gas oil	36·09	23·68	13·46
Fuel and diesel oils	29·85	20·19	9·56
Other sorts	418·78	—	76·13
Total refined products	36·42	28·11	15·48
	£ *per cwt*		
Paraffin wax ..	3·21	2·94	0·78
Mineral jelly ..	1·77	1·75	1·14
Carbon black from natural gas ..	3·05	2·79	1·33
	£ *per ton*		
Natural asphalt and bitumen	10·19	11·72	3·68

followed by fuel and diesel oils 47·8 per cent, motor spirit 37·5 per cent, kerosine 35·4 per cent, crude petroleum 26 per cent, and lubricating oil 20·7 per cent.

In the case of other products the increases were comparatively slight and for natural asphalt and bitumen there was a decline of 13·1 per cent.

Consigning Countries

In Table III are given such details as are available as to countries consigning petroleum to the United Kingdom, but it must be emphasized that the country of consignment is not necessarily the country of origin of the oil.

TABLE III

COUNTRIES CONSIGNING PETROLEUM TO THE U.K.

Country and Product	January to June 1948 1000 *gal*	1947 1000 *gal*	Half of year 1938 1000 *gal*
BRITISH WEST INDIES:			
Motor spirit ..	44,031	45,687	45,304
Kerosine ..	29,203	40,699	—
Fuel & diesel oils	36,805	37,972	59,068
	110,039	124,358	104,372
BAHREIN, KUWAIT, QUATAR & TRUCIAL OMAN:			
Crude petroleum	44,056	26,011	—
Motor spirit ..	13,738	11,892	—
Kerosine ..	10,990	19,899	—
	68,784	57,802	—
PALESTINE:			
Motor spirit ..	13,599	22,027	—
OTHER BRITISH COUNTRIES:			
Crude petroleum	23,133	1	10,196
Motor spirit ..	73	—	4,012
Kerosine ..	—	1	1,428
Fuel & diesel oils	9,053	6,110	598
Lubricating oil	14	92	40
Gas oil	21,979	6,630	6,020
	54,252	12,834	22,294
NETH. WEST INDIES:			
Crude petroleum	136,793	98,629	80,392
Motor spirit ..	243,260	187,622	294,764
Kerosine ..	99,262	56,448	25,446
Fuel & diesel oil	425,567	61,531	125,644
Lubricating oil	3,508	11,119	—
Gas oil	69,652	32,612	10,968
	978,042	447,961	537,214
UNITED STATES:			
Crude petroleum	12,251	6,163	7,498
Motor spirit ..	119,802	272,772	157,248
Kerosine ..	1,768	32,389	28,900
Fuel & deisel oils	7,566	2,280	31,656
Lubricating oil	42,913	38,505	42,830
Gas oil	79,917	85,249	19,702
	264,217	437,358	287,834
IRAN:			
Crude petroleum	111,600	65,689	27,110
Motor spirit ..	77,585	9,992	157,034
Kerosine ..	59,223	17,448	29,942
Fuel & diesel oils	197,848	122,078	80,682
Gas oil	56,143	1,277	18,546
	502,399	216,484	313,314
SAUDI ARABIA:			
Crude petroleum	68,386	8,057	—
IRAQ:			
Crude petroleum	40,830	—	70,898
VENEZUELA:			
Crude petroleum	19,420	84,210	69,488
Motor spirit ..	8,323	16,954	—
Fuel & diesel oils	2,376	3,570	6,930
Gas oil	3,787	19,011	—
	33,906	123,745	76,418
PERU:			
Crude petroleum	16,146	8,907	10,932
SOVIET UNION:			
Motor spirit ..	5,706	—	23,730
Lubricating oil	—	—	6,680
	5,706	—	30,410
NETHERLANDS EAST INDIES:			
Motor spirit ..	—	—	11,928
OTHER FOREIGN COUNTRIES:			
Crude petroleum	11,384	—	7,464
Motor spirit ..	15,542	2,874	34,314
Kerosine ..	—	3,279	17,466
Fuel & diesel oils	16,344	7,107	39,092
Lubricating oil	13	35	4,550
Gas oil	14,095	3	23,728
	57,378	13,298	126,614

It is of interest to note that figures are now being disclosed for the quantities of petroleum products imported from the Middle East countries of Bahrein, Kuwait, Quatar and Trucial Oman, and from Saudi Arabia. For the first four of these the 1948 group total is 19 per cent higher than in the first half of 1947, but from Saudi Arabia the quantity is over eight times as great as in that period.

It is also noteworthy that, while in the comparable periods imports from the United States were reduced by 39·6 per cent, those from the Netherlands West Indies were more than doubled. However, from Venezuela there was a decrease of 72·6 per cent as an offset to the increase from the N.W.I. The quantities consigned from the British West Indies was lower by 11·5 per cent.

From Iran the quantities consigned to the U.K. were more than doubled in the first half of 1948 in comparison with the same period of 1947, with an eight-fold increase in the case of motor spirit and gas oil up from 1·28 million to 56·1 million gallons.

Re-exports

Re-exports of imported oils were somewhat under half the total in quantity in comparison with 1947 and, as will be seen from Table IV, the value was correspondingly lower. Bunker fuel shipped for the use of steamers engaged in the foreign trade (including fishing vessels) showed an increase of 28·2 per cent over the preceding year.

TABLE IV

U.K. RE-EXPORTS OF IMPORTED PETROLEUM

	January to June 1948	January to June 1947	Half of year 1938
	1000 *gal*	1000 *gal*	1000 *gal*
Motor spirit ..	5,153	36,702	7,038
Kerosine	1,011	1,416	1,416
Lubricating oil ..	798	1,370	2,172
Fuel & diesel oils	17,334	22,859	2,142
All other sorts ..	953	2,582	1,798
	25,249	64,929	14,566
Value ..	£931,713	£2,143,310	£400,250
Oil fuel for use in steamers ..	254,268	198,290	156,602

Exports

Details of exports of petroleum products produced or manufactured in the United Kingdom are set out in Table V. From this table it will be seen that, while the quantity of these exports decreased by 48·1 per cent in the comparable periods of 1948 and 1947, there was an increase of 3·6 per cent in value. Average values in £ per 1000 gallons for the first half of 1948 were: motor spirit, £48·59; lubricating oil, £152·7; gas oil, £33·76; fuel and diesel oils, £28·13.

TABLE V

U.K. EXPORTS OF HOME-PRODUCED AND MANUFACTURED PETROLEUM

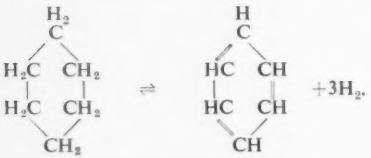
	January to June, 1948		January to June, 1947		Half of year 1938	
	Quantity 1000 *gal*	*Value* £	*Quantity* 1000 *gal*	*Value* £	*Quantity* 1000 *gal*	*Value* £
Motor spirit ..	2,262	109,917	8,745	306,502	27,492	442,484
Lubricating oil ..	13,215	2,017,909	13,101	1,513,487	8,734	580,760
Gas oil	2,099	70,853	10,229	254,582	14,564	192,218
Fuel and diesel oil ..	834	23,464	3,514	72,218	8,600	89,170
All other sorts ..	643	86,286	1,109	81,082	7,450	122,338
Total	19,053	£2,308,429	36,698	£2,227,871	66,840	£1,426,970
	Cwt		*Cwt*		*Cwt*	
Lubricating compounds	57,227	202,875	41,679	139,069	302,632	357,182
Paraffin wax ..	31,677	126,235	39,432	143,039	44,008	37,956
	Tons		*Tons*		*Tons*	
Manufactured bituminous asphalts and emulsions	37,926	489,335	26,676	318,386	45,964	213,030

HYDROFORMING

By C. M. CAWLEY*

HYDROFORMING is a process for the treatment of naphthenic and paraffinic naphthas to yield products rich in aromatics. It was devised as a means of raising the octane number of petrols, but was used extensively in America during the war for the production of toluene.

The chief reaction which occurs during hydroforming is the dehydrogenation of naphthenes to aromatics, the simplest example being the conversion of *cyclo*hexane to benzene:



The position of equilibrium in this reaction is influenced by the temperature and the pressure of hydrogen; increase in temperature favours the reaction to the right, while increase in hydrogen pressure favours that to the left. At atmospheric pressure, dehydrogenation is practically complete at temperatures above 300° C.

Dehydrogenation takes place very slowly under purely thermal conditions, but occurs rapidly in the presence of catalysts such as nickel or palladium at a temperature of about 300° C. These catalysts are poisoned by sulphur, and the dehydrogenation of petroleum products on a large scale was therefore not practicable until sulphur-resistant catalysts had been developed. The catalysts usually employed, namely molybdenum oxide, or chromium oxide, supported on alumina, are less active than nickel, and are consequently used at a temperature in the region of 500° C.

Condensation reactions occur readily at this temperature in the absence of hydrogen, and the catalysts lose activity rapidly because of the deposition of complex condensation products. The process is therefore conducted under a pressure of hydrogen of 10 to 20 atmospheres in order to suppress condensation reactions. The presence of hydrogen under pressure displaces the equilibrium in the above reaction to the left, but at 500° C and 20 atmospheres, the equilibrium concentration of *cyclo*hexane is only a small fraction of one per cent. Thus the use of hydrogen under pressure has little influence on the reactions except to reduce the amount of condensation, and hence to prolong the "life" of the catalyst. Even with hydrogen present, a sufficient activity of the catalyst is not maintained for more than about 12 hours, and periodic regeneration by air oxidation is accordingly necessary.

Although the dehydrogenation of naphthenes is the main reaction occuring during hydroforming, other reactions also take place. These include the formation of aromatics by the cyclization of paraffins and olefins, and the isomerization of alkyl*cyclo*pentanes, as for example the conversion of methyl*cyclo*pentane to *cyclo*hexane which is then dehydrogenated to benzene. In addition, the decomposition of sulphur compounds takes place and results in the liberation of sulphur as hydrogen sulphide. This is of importance in the treatment of straight-run petrols, particularly because of the beneficial effect of sulphur removal on lead susceptibility.

The hydroforming process was devised by the I.G. Farbenindustrie A.-G., and a pilot plant was built at Leuna. This consisted of two units, each of three reactors, one unit being on stream while the catalyst in the other was being

* Fuel Research Station, Department of Scientific and Industrial Research.

regenerated. The catalyst, molybdic oxide (5 to 10 per cent) supported on activated alumina, was varied in particle size and molybdenum content in different parts of the system in order to make the deposition of carbon as uniform as possible.

The material treated was straight-run petrol, topped to 90° C. This was heated by interchange with the products, mixed with 600 to 1000 cu.m. circulating gas (containing 50 to 60 per cent hydrogen) per metric ton, and preheated to 520° C under a pressure of 15 atmospheres. As dehydrogenation reactions are endothermic, the temperature falls during the treatment and further preheating was consequently carried out between reactors. The throughput was about 0·6 litre naphtha per litre of catalyst per hour and the running and regeneration periods were of 6 to 12 hours' duration.

Regeneration was carried out by burning off the deposits of carbon (about 1 per cent of the petrol) by circulating inert gas containing amounts of air rising from 1 to 1½ per cent at the beginning to 10 to 15 per cent at the end of the reactivation period. In this way the reaction was controlled so that the temperature never exceeded 550° C, and the total life of the catalyst thus obtained was normally about six months.

The only large-scale plant designed and operated along these lines in Germany was at Moosbierbaum. This had a design capacity of 106,000 metric tons of finished fuel per year, but the maximum rate of production, reached in late 1943 and early 1944, was 84,000 metric tons per year. The raw material was entirely straight-run petroleum naphtha, which gave a liquid yield of 72 to 73 per cent by weight. This was combined with the light fraction boiling up to 90° C, to give a total yield of 76 per cent of the original straight-run petrol. The final product had an aromatic content of 50 to 55 per cent and an octane number of 80 (C.F.R. Motor Method), which could be raised to 91 by the addition of 0·12 per cent tetra ethyl lead (T.E.L.).

All the later plants built in Germany were based on a modified type of hydroforming process known as the D.H.D. (dehydrierung-hoch-druck) process. This was used for increasing the aromatic content of petrols produced by the destructive hydrogenation of coal, tar, and other carbonaceous materials. The naphthas from these petrols were found to give a smaller deposit of carbon than straight-run petroleum naphthas and, as the rate of carbon deposition was further reduced by working at a higher pressure (25 to 70 atmospheres), it was possible to operate with a single reactor system which was off stream for catalyst revivification for only one-tenth of the time.

Hydrogenation petrol topped to 85° C, mixed with 1000 cu.m. circulating gas per metric ton, was passed to a series of three or four reactors where treatment was carried out at a temperature of 500 to 530° C, and finally to a converter operating at 300° C for the hydrogenation of unsaturated constituents. The throughput was 0·4 litre per litre of catalyst per hour. When treated at the higher pressures, hydrogenation naphtha gave an on-stream period of about 240 hours; this was reduced when petroleum naphthas were treated or lower pressures used. The catalyst was molybdic oxide (8 to 10 per cent) on activated alumina, and the amount of carbon deposited varied from 0·2 per cent of the feed with the more naphthenic petrols to 1·0 per cent with paraffinic petrols. Reactivation was affected by controlled oxidation carried out in a manner similar to that used in the hydroforming process, and with the necessary purging operations was completed in less than 24 hours. The total life of the catalyst was about twelve months.

The yields of liquid products were higher from the feedstocks containing

higher proportions of naphthenes, and were thus greatest from the hydrogenation petrols derived from bituminous coal and coal-tar. These raw materials gave a final D.H.D. petrol yield, after blending with the fraction to 85° C, of about 80 per cent, and heavy residue of 3 to 4 per cent. The D.H.D. petrol had an aromatic content of 50 to 55 per cent and an octane number (C.F.R. Motor Method) of 80, or 91 with the addition of 0·12 per cent T.E.L.

The output of D.H.D. petrol from a five-converter unit was about 100,000 metric tons a year. The total plant capacity in operation in Germany was about 700,000 metric tons a year, and additional plant with a capacity of about a million metric tons a year was being erected. The Germans relied on the D.H.D. and the hydroforming process to a very large extent for improving the quality of aviation spirits during the war. Their development of butane dehydrogenation to provide butylene for the production of *iso*octane or alkylate lagged far behind that of Britain and America.

In the United States, the hydroforming process was developed in the first instance as a means of up-grading straight-run petrols, and the first commercial unit was started up in 1940. During the war, the existing plants were used for the production of toluene and high-octane aviation-base blending stock, and additional plants were erected for the same purpose. There are eight plants in all, and these are now again in operation for improving the octane number and reducing the sulphur content of low-grade petrols.

The process employed in America is in principle the same as that used in Germany. The treatment is carried out at a pressure of 10 to 20 atmospheres, and a temperature of about 500° C, over a granular or pelleted catalyst consisting of molybdenum oxide (10 per cent) on alumina. A plant usually comprises four reactors, two of which are on stream in series for a period of 4 to 8 hours, while the catalyst in the other two is being reactivated. While the dehydrogenation reactions are in progress the temperature falls, perhaps as much as from 510° C at the inlet to 460° C at the outlet, and additional heat is therefore supplied in reheat coils installed between reactors. The raw material is usually a naphtha from which the light spirit has been removed, and the throughput varies from 0·5 to 1·0 vol per vol catalyst per hour.

The amount of carbon deposited on the catalyst varies from 0·8 to 2·0 per cent of the feed, and is removed during the reactivation process by oxidation with a mixture of air and inert gas containing 1 to 2 per cent of oxygen. The temperature is not allowed to exceed 590° C and to ensure complete regeneration, both down-flow and up-flow burning are employed. Much of the sulphur in the feed is retained on the catalyst as molybdenum sulphide, which is converted back to the oxide during reactivation. The catalyst recovers its activity almost completely and has been used for periods of more than a year without replacement.

The octane numbers of hydroformed petrols can be varied within fairly wide limits by altering the operating conditions. As the treatment is made more severe, the octane number of the petrol is increased while the yield is reduced, and a greater amount of gas is formed. Thus the octane number can range from 66 to 79·5 as the volume yield is reduced from 90·6 to 77·6 per cent. The yield-octane relationships of hydroforming show an appreciable advantage over those of thermal reforming processes.

Another feature of hydroforming is the low Reid vapour pressure (R.v.p.) of the product, which makes it possible to blend in 3 to 9 per cent of butane to bring the hydroformate up to 10 lb R.v.p., and hence to effect an improvement in yield and octane number.

Hydroformed petrols have a good lead susceptibility, the octane number being, for example, raised from 76·6 to 82·6 by the addition of 1 ml T.E.L. per gallon.

For the production of toluene during the war the process was operated in a very similar manner except that the reaction temperature was higher, and the products were recycled to obtain the maximum yield of toluene. The feed materials were specially selected fractions, usually boiling in the range 80° to 113° C with a high content of "natural" toluene and of methyl*cyclo*hexane which is converted to toluene by dehydrogenation. Hydroforming made a substantial contribution to the Allied war effort and it is estimated that 250,000 tons of toluene were produced by this process in 1944.

Hydroforming may be similarly employed for the preparation of other aromatic hydrocarbons. Thus it can be used, by the choice of a suitable feedstock, for the production of xylenes, the ortho-isomer of which is assuming a growing importance in replacing naphthalene as the raw material for the manufacture of phthalic anhydride by oxidation.

In conclusion, it may be said that while hydroforming is undoubtedly a technically attractive process for the upgrading of petrols, cost data which would permit an assessment of the process to be made are lacking. It may be that the process will have its greatest value for the production of aromatic hydrocarbons for special purposes.

REFERENCES

"The Hydroforming Process", G. Armistead. *Oil Gas* J., 31.8.46, **45** (17), 85.

"Hydroforming for Production of High Octane Motor Fuel", L. R. Hill, G. A. Vincent, and E. F. Everett. *Trans. Amer. Inst. Chem. Engrs.*, 1946, **42**, 611; *Nat. Petrol News*, 1946, **38**, 456.

Report on the Petroleum and Synthetic Oil Industry of Germany. H.M. Stationery Office, 1947.

"Aromatics from Petroleum", H. Steiner. *J. Inst. Petrol*, 1947, **33**, 410–35.

SBERNADORI'S PETROLEUM COMMERCIAL RULER

Reviewed by H. HYAMS (Fellow) and B. C. FERGUSON

A NEW slide rule for the interconversion of weights per unit volume and volumes per unit weight in the Imperial, metric, and U.S. systems, and for the calculation of prices in sterling and dollars of products of specific gravity range of 0·600 to 1·100, has recently been introduced by Dr Sbernadori of Rome.

This rule consists essentially of two fixed logarithmic scales graduated in volume or price per unit volume, and weight or price per unit weight, together with two movable scales graduated in the Imperial, Metric, and U.S. units of volume and weight most commonly used in the marketing of petroleum products. The two movable scales are also provided with a scale of specific gravity and logarithmic scales for interconverting sterling to U.S. dollars, or other decimal monetary systems, at varying rates of exchange.

The rule has also two ancillary scales for interconverting gravities in °A.P.I. to specific gravity 60° F/60° F and temperature in degrees Centigrade to temperature in degrees Fahrenheit. In addition one edge of the rule is graduated

partly in inches and thirty-seconds of an inch and partly in centimetres and millimetres.

A specimen of the rule was submitted for examination and found to be well made, the slides being constructed of a white opaque plastic material and the stock of plastic and aluminium. The manufacturers claim that the material used is unaffected by temperature changes and is impervious to water, chemicals, and petroleum products.

For ease of reading, the weight datum marks and scales are coloured black and volume datum marks red.

The overall length of the scale is about 12 inches and it is provided with a leather case and a book of instructions.

There is little doubt that a rule of this nature would fulfil a most useful purpose in the petroleum industry, particularly for converting prices in cents of U.S. dollars per U.S. gallon or barrel to prices in sterling per long ton, etc., provided that such a scale can be read with a reasonable degree of accuracy.

The designer claims that this rule gives a direct reading, accurate to 0·2 per cent and that this accuracy can of course be increased by the ordinary method of repeating calculations successively by units, tenths, hundredths, etc.

It is doubtful whether Dr Sbernadori's claim for this accuracy can be substantiated in practice, partly because the main scales are based on a modulus of only 6 cm, but more particularly owing to the short specific gravity scale. This scale, for the range of specific gravity 0·600 to 1·100, is only approximately $\frac{5}{8}$ inch in length. Thus, to obtain settings of 0·010 specific gravity it is necessary to estimate by eye between 0·02 inch and 0·01 inch according to the position on the scale. An error in reading of 0·01 inch would, for example, give an uncertainty in any calculation involving specific gravity of between 0·8 and 0·9 per cent.

No cursor is fitted to the rule and this is a great drawback. It is felt that if a magnifying cursor were fitted it would be possible to approach more closely the accuracy claimed.

The specimen rule examined appeared in general to be accurately divided although one or two slight inaccuracies in scale division were noted. All datum marks appear to be accurately located with the exception of the litre/cubic metre marks which were about one hundredth of an inch out. Any calculations involving litres or cubic metres would therefore be in error by an additional 0·1 per cent. It was also noted that the graduations of the volume scale were not carried right to the edge of the scale. Whilst this would not be important if a cursor were used, it would make reading without one a little more uncertain.

Other improvements which the use of the scale have suggested are as follows:

(*a*) The °A.P.I./specific gravity conversion scale could be extended to the full length of the rule by placing the temperature conversion scale on the back of the rule. This would lengthen the specific gravity scale from three to twelve inches and would permit the °A.P.I. scale being subdivided in intervals of 1° A.P.I.

(*b*) To save time in calculations involving products whose gravities are quoted in A.P.I. degrees it would be useful if the movable scales were graduated in A.P.I. degrees as well as specific gravity 60° F./60° F.

(*c*) Where prices in sterling per Imperial measure are required as equivalents of cents or dollars per U.S. gallon or barrel, much time would be saved by having a datum line inscribed on the face of the movable scales for use with a cursor and a subsidiary graduation on the reverse side of the movable scales giving direct reading in sterling per long ton, etc.

In conclusion it is observed that whereas rapidity and ease in oil measurement calculations are very desirable, in view of the tendency for increased standards of accuracy in all aspects of oil measurement such considerations are relatively unimportant if they offset accuracy. This slide rule in its present form is considered, therefore, to have only a limited application in the petroleum industry, but would be very useful to those who wish to make a rapid "spot" calculation without great accuracy.

The rule can be purchased from Paolo Sbernadori, via Bartolomeo Eustachio 7, Rome, Italy, the price being £5 4*s*. in leather case and £4 18*s*. in leatherette case.

"TABLES FOR MEASUREMENT OF OIL"

Users of the above book should note the following corrigenda:

Arguments		Legend
Sp. gr.	Temp.	should read
Table 11, *page* 57		
0·603	90	0·6195
Table 12, *page* 230		
0·605	96	0·9659
0·605	97	0·9649
0·605	98	0·9640
0·605	99	0·9630
0·605	100	0·9620

PORTABLE FIRE EXTINGUISHERS

SPECIFICATIONS for three types of portable fire extinguisher have recently been issued by the B.S.I. They are B.S. 138: 1948, water type (soda acid); B.S. 740: Part I: 1948, foam type; B.S. 1382: 1948, water type (gas pressure). Each specification is priced at 2*s*. 6*d*. post free, and copies are obtainable from the B.S.I. at 24–28 Victoria Street, London, S.W.1.

BITUMINOUS SAND SEPARATION

THE 1947 Annual Report* of the Research Council for Alberta states that it was noted in previous reports that the hot-water separation process does not recover all the oil content of bituminous sand. The recovery of oil is between 80 and 90 per cent for good grades of sand. It is of interest to know what becomes of the oil that is not recovered and work in the laboratory has been devoted to finding this out. The oil that is not recovered becomes dispersed in the plant water and eventually leaves the plant with the tailings. The more clay there is in the bituminous sand, the more oil that becomes dispersed in the water and that is lost with the tailings. Careful laboratory testing has made this point clear. There is the further point of just how the oil becomes dispersed. It was suggested in the last report that the lost oil forms films over the mineral particles —grains of sand, silt, and clay—and leaves the plant with the mineral particle when these are eliminated as tailings. A given weight of clay, because of the extremely small size of its particles and the consequent large development of surface would have much more oil filmed on its particle surfaces than an equal weight of sand or even silt. Thus, it would be understandable why an increase of a few per cent in the clay content of a bituminous sand would result in a notable increase in the loss of oil with the tailings from the separation plant.

Further work during the past year indicates that the loss of oil is not due to filming on to particle surfaces. What seems to happen is that, during the separation process, all the oil becomes dispersed into flecks of varying size. Those above some fairly critical size are collected by air bubbles and are carried to the surface of the water as

*"Twenty-eighth Annual Report of the Research Council of Alberta, 1947." Edmonton: King's Printer, 1948.

a froth which is removed as recovered oil. Those of smaller size are not collected by the air and stay suspended in the water. The oil found in the tailings, then, is not there as films on particle surfaces but as flecks enmeshed among the particles. The oil flecks settle in water slowly, especially the very small ones, because the specific gravities of oil and water are so nearly equal. Thus, when tailings are redispersed in water and are separated into fractions of varying ranges of sizes of particles by varying times of settling, a high proportion of the oil flecks settle with the finest mineral matter, namely, the clay. It is the clay in the bituminous sand which causes the oil to disperse into flecks and an increase of clay content results in an increase in the proportion of the oil that forms very small flecks. Hence increase of clay content is accompanied by decrease of oil recovery in the separation process.

Work has been continued during the year on the applicability of water-flooding to the bituminous sands. The purpose of it is to collect fundamental data upon which to base a judgment about whether or not this method of recovery of oil from the bituminous beds is feasible. One item of information which is vital is the temperature of the bituminous sand formation. The Department of Mines and Resources, in its report on core-drilling operations, gives temperature data which indicated that the formation temperature is 45° F or less. Through the co-operation of Abasand Oils Ltd., a suitable thermometer was lowered into a mud-filled drill-hole to a depth of 130 feet. The temperature recorded was 36° F. It is thus apparent that the bituminous sand beds are at a temperature that is close to the freezing point of water.

Measurements of the viscosity of the bituminous sand oil and of the viscosity-temperature relationship show that the viscosity decreases very rapidly as the temperature rises from 32° F to about 100° F and that it decreases slowly above about 150° F. Between 100° F and 150° F there is quite abrupt change in the viscosity-temperature relationship. As for values for the viscosities of the oil, it would be misleading to give any at present. The measurements are very sensitive to variations in the composition of the oil and to the presence of small percentages of clayey mineral matter. The oil must be extracted from the bituminous sand before measurements can be made and the extraction procedure either removes some of the lighter fractions of the oil or leaves some solvent in the oil or both. Also there is always some clayey material in the oil that must be used for measurements. A careful study of the effect of these conditions on viscosity and of how corrections can be applied to compensate for them is under way. Announcement of actual viscosity values is being postponed until this study has been brought to a satisfactory status.

It can be said with considerable definiteness that the viscosity of the bituminous sand oil at formation temperature is too great for water-flooding and that a successful application of this method of oil recovery will involve the heating of the bituminous sand beds, in place, to temperatures above 100° F. Water under practicable pressure gradients will flow through bituminous sand at 36° F and will displace oil. The flow is small, however, and the ratio of water to oil in the flow is high. At 150° F, on the other hand, the flow is usefully great and half of the oil is displaced before the ratio of water to oil in the flow becomes unduly high. It is expected that these qualitative statements can be replaced by actual data by the time the next annual report is due.

TYLORS
OF
LONDON

MANUFACTURERS
OF
METERS
FOR
PETROLEUM
PRODUCTS

Tylor bulk petrol meter is approved by the Board of Trade (Standards Dept.)

FLOW CONTROL PROBLEMS
OUR SPECIALITY

Illustration shows Motor-driven Portable Unit with Air Elimination Device

HEAD OFFICE AND WORKS
BELLE ISLE
LONDON, N.7

OIL DEVELOPMENTS IN CUBA

THE outstanding developments in petroleum explorations in Cuba in 1947 were the withdrawal from such activities of the Standard Oil Company of Cuba and the engaging therein of the Cia. Petrolera Eureka, a subsidiary of the Gulf Oil Co., states the U.S. Bureau of Mines.* Two shallow holes were completed by the Standard Oil Company of Cuba before withdrawing and one hole and a core hole were completed by the Petrolera La Estrella de Cuba, all of which were dry. Motembo naphtha production continued to decline while output of Jarahueca light gravity oil of naphtha characteristics was maintained throughout the year at a level adequate to meet the requirements of the two small skimming plants in that field. Erection of a new, small modern refinery for handling Jarahueca crude oil was initiated.

* *Intern. Petrol. Trade*, 1948, **17**, 75.

FORTHCOMING MEETINGS

INSTITUTE MEETINGS

Integration of Operations in a Large Refinery. K. B. Ross and D. N. McKinley. At 26 Portland Place, London, W. 1, 5.30 p.m. (tea 5 p.m), Oct. 14.

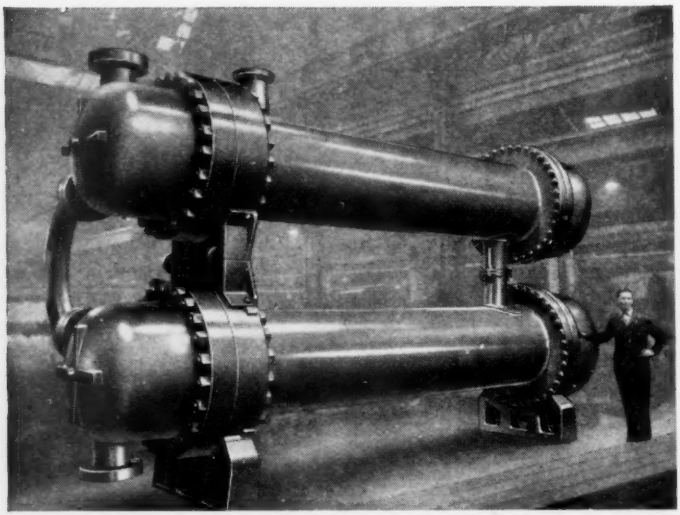
Detergency of Carbon Black in Hydrocarbon Solution. F. H. Garner and A. R. W. Baddeley. At 26 Portland Place, London, W.1, 5.30 p.m. (tea 5 p.m.), November 10.

Evaporation Losses at Marketing Installations. R. L. Sarjeant. At 26 Portland Place, London, W.1, 5.30 p.m. (tea 5 p.m.), December 8.

SITUATIONS VACANT

REFINERY Superintendent is required by an Australian company for a small cracking, reforming, and polymer plant in Australia. University degree or equivalent and experience of operations mentioned are desired. Salary according to qualifications but not less than £1000 (Australian) annually. Passage provided. Further particulars obtainable from Australia House (Room 115), Strand, London, W.C.2.

HEAT EXCHANGE EQUIPMENT



HIGH PRESSURE HEAT EXCHANGERS

Surface per Unit	... ...	2170 sq. feet
Working Pressure in Tubes	...	1500 lb. per sq. inch

These two Units form part of a battery comprising 60 similar Units and having a Crude Oil throughput of 4½ million gallons per day.

A. F. CRAIG & CO., LTD.

CALEDONIA ENGINEERING WORKS

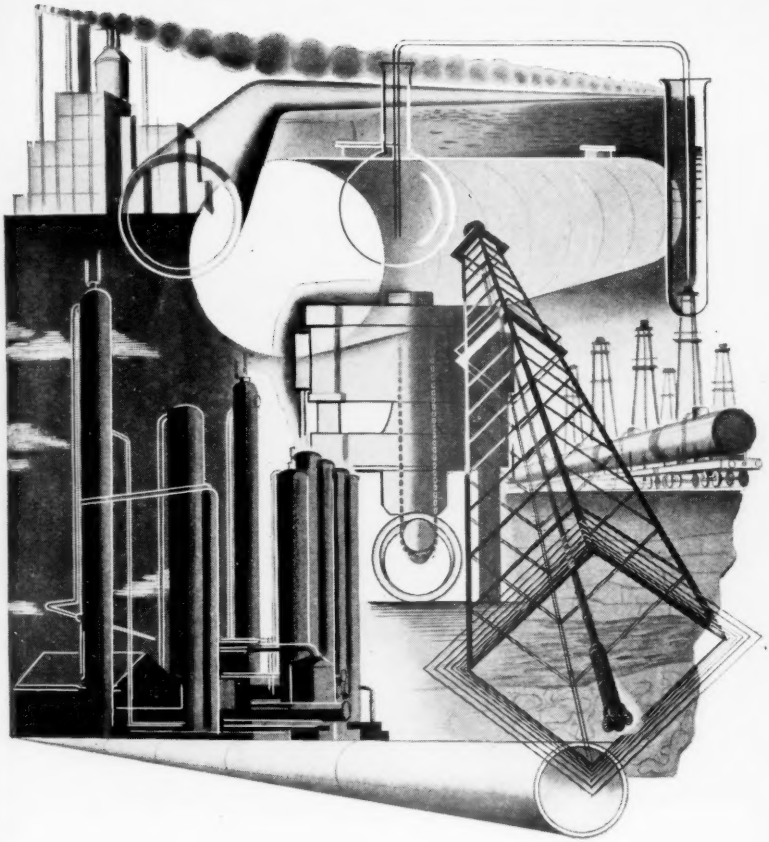
PAISLEY——————SCOTLAND

London Office: SALISBURY HOUSE, LONDON WALL, E.C.2

Telephone: MONarch **4756**

American Associates:

THE KOCH ENGINEERING COMPANY, INC., WICHITA, KANSAS



STEELS
FOR THE
PETROLEUM
INDUSTRY

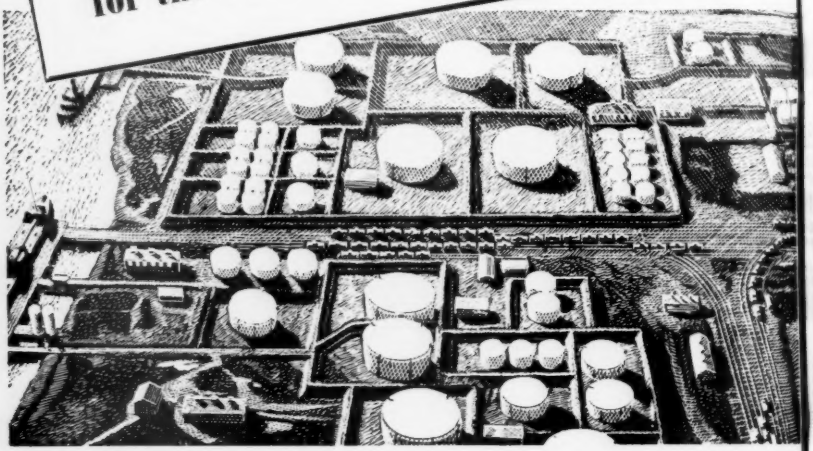
THE UNITED STEEL COMPANIES LTD

THE UNITED STEEL COMPANIES LIMITED

17 WESTBOURNE ROAD - SHEFFIELD 10 - ENGLAND

A.T.M.

Supervisory Remote Control Equipment for the PETROLEUM INDUSTRY



The exceptionally long pipe lines and extensive electrical power networks of large petroleum undertakings demand centralised supervision and control. A.T.M. Supervisory Remote Control Equipment provides the economic solution for these exacting requirements, including: —

- The certain and rapid selective remote operation of distant switchgear, pumps, valves, etc., also metering facilities.
- A system of selective telephones for the pipe line pumping stations, with point to point intercommunication facilities.
- A compact yet comprehensive wall diagram, of the flexible mosaic type, for the control room.

In addition, the A.T.M. automatic auto-exchange coupling system, which is certified as intrinsically safe for use in gaseous atmospheres, is available for installation in refineries and in the vicinity of oil storage tanks to enable direct connection by fully automatic dial telephones to be made throughout the entire plant.

AUTOMATIC TELEPHONE & ELECTRIC CO. LTD.

Export Dept: NORFOLK HOUSE, NORFOLK STREET, LONDON, W.C.2.
TEMple Bar 9262.
Inland Telegrams: AUTELCO, ESTRAND, LONDON. Cables: AUTELCO, LONDON.
STROWGER WORKS, LIVERPOOL, 7, ENGLAND.

A4211-C2

MANUFACTURERS

TO THE

BONA FIDE OIL TRADE only.

ECLIPSOL OIL CO. LTD.,

ROEBUCK LANE,

WEST BROMWICH.

PHONE:
WEST BROMWICH 0431-2-3-4.

GRAMS:
SOLUBLE, WEST BROMWICH.

Printed by Jarrold & Sons, Ltd., Norwich

Whatever method of transport employed, a Metal Container will carry it safely.

METAL CONTAINERS

METAL CONTAINERS LTD., 17 WATERLOO PLACE, PALL MALL, LONDON
WORKS: ELLESMERE PORT & RENFREW ASSOCIATED COMPANIES OVERSEAS

M·W 6

M.W 6